resistance in FIG. 19 is evaluated as stated below. Processing after the evaluation of the gradient increment resistance is the same as in FIG. 19. First, the temporal variation of the throttle valve opening as shown in FIG. 21(*a*) is measured. Subsequently, the time derivative of the throttle valve opening is obtained as shown in FIG. 21(*b*). The acceleration request α is calculated in accordance with the preset functional relationship of the following equation (5), on the basis of the throttle valve opening (TVO) and the time derivative thereof:

$$\alpha = f(\Delta TVO/\Delta T,\ TVO,\ t) \tag{5}$$

An example of the obtained result of the acceleration request α is shown in FIG. 21(*c*). In this manner, the presence of the acceleration request α is decided when the throttle valve opening and the differentiated value thereof have predetermined values or above.

The gradient increment resistance ΔL is calculated by the following equation (6) on the basis of the vehicle weight W, the gradient θ and the decided acceleration request α:

$$\Delta L = W \cdot g \cdot \sin\theta + W \cdot \alpha \tag{6}$$

With this embodiment, a smooth shift operation with the acceleration request also taken into consideration can be realized.

As described above, according to the present invention, the vehicle weight is estimated from the drive characteristics of the automobile, the output torque is estimated from the slip of the torque converter or from the revolution speed of the engine and the opening of the throttle valve, and the running load is estimated from the output torque and the acceleration. Then, in the upshift operation, the gear shift boundary is moved by utilizing both the vehicle weight and the running load, while in the downshift operation, it is moved in consideration of only the running load. Thus, the fuel consumption is enhanced, and the exact shift operation conformed to the drive conditions is realized.

Incidentally, although the foregoing embodiments have been described as estimating the vehicle weight, the present invention is not restricted thereto. The vehicle weight may well be directly measured by a sensor.

According to the present invention, a running load is estimated, and a shift operation conformed to a vehicle weight and the running load is performed. It is therefore possible to provide an automatic transmission control system for an automobile in which the optimal shift pattern is formed in conformity with a driving environment (such as driving on a mountain path, or driving with many passengers on board), thereby enhancing the drivability of the automobile, and in which the fuel consumption of the automobile is enhanced more than in the prior art when driving on a flat road.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.

What is claimed is:

1. System for controlling selection of gear position for an automatic transmission of an automobile comprising:

weight estimation means for estimating a total weight of said automobile;

acceleration input means for receiving an acceleration signal indicative of acceleration of said automobile;

output torque estimation means for estimating an output torque based on torque characteristics of a drive train of said automobile;

running load estimation means for estimating a running load from the estimated weight of the automobile, the acceleration, and the estimated output torque;

memory means for storing at least two shift schedules therein;

a shift schedule variable-control unit which determines a shift schedule of an automatic transmission of said drive train during actual running of said automobile on the basis of the estimated running load, the estimated weight of the automobile and the stored shift schedules; and

gear shift determination means for selecting a gear position of said automatic transmission based on the determined shift schedule;

wherein said output torque estimation means estimates said output torque based on torque characteristics of an engine of said drive train when a ratio between an input revolution speed and an output revolution speed of said torque converter is greater than a predetermined value, and based on torque characteristics of a torque converter of said automatic transmission when said ratio is less than said predetermined value.

2. System for controlling selection of gear position for an automatic transmission of an automobile, comprising:

weight estimation means for estimating a total weight of said automobile;

acceleration input means for receiving an acceleration signal indicative of acceleration of said automobile;

output torque estimation means for estimating an output torque based on torque characteristics of a drive train of said automobile;

running load estimation means for estimating a running load from the estimated weight of the automobile, the acceleration, and the estimated output torque;

memory means for storing at least two shift schedules therein;

a shift schedule variable-control unit which determines a shift schedule of an automatic transmission of said drive train during actual running of said automobile on the basis of the estimated running load, the estimated weight of the automobile and the stored shift schedules;

gear shift determination means for selecting a gear position of said automatic transmission based on the determined shift schedule; and

a neural network which has stored therein values of at least a throttle valve opening and said acceleration of the automobile for learning values of a vehicle weight corresponding to the values of at least said throttle valve opening and said accelerations;

wherein said vehicle weight estimation means estimates said vehicle weight by time-serializing each of at least said throttle valve opening and said acceleration and then supplying resultant time-serial signals to said neural network.

3. An automatic transmission control system for an automobile as defined in claim 2, wherein said vehicle weight estimation means includes means for supplying said time-serial signals of said throttle valve opening and said acceleration, commencing when said throttle valve opening has exceeded a second predetermined value and said acceleration has also exceeded a third predetermined value.

4. System for controlling selection of gear position for an automatic transmission of an automobile, comprising:

weight estimation means for estimating a total weight of said automobile;

acceleration input means for receiving an acceleration signal indicative of acceleration of said automobile;

output torque estimation means for estimating an output torque based on torque characteristics of a drive train of said automobile;

running load estimation means for estimating a running load from the estimated weight of the automobile, the acceleration, and the estimated output torque;

memory means for storing at least two shift schedules therein;

a shift schedule variable-control unit which determines a shift schedule of an automatic transmission of said drive train during actual running of said automobile on the basis of the estimated running load, the estimated weight of the automobile and the stored shift schedules; and

gear shift determination means for selecting a gear position of said automatic transmission based on the determined shift schedule;

wherein said vehicle weight estimation means estimates said vehicle weight of said automobile in response to a throttle valve opening signal and a vehicle speed signal in addition to said acceleration signal; and

wherein said output torque estimation means estimates said output torque in response to a revolution speed signal of an engine of said drive train and a turbine revolution speed signal of a torque converter of said automatic transmission.

5. System for controlling selection of gear position for an automatic transmission of an automobile, comprising:

weight estimation means for estimating a total weight of said automobile;

acceleration input means for receiving an acceleration signal indicative of acceleration of said automobile;

output torque estimation means for estimating an output torque based on torque characteristics of a drive train of said automobile;

running load estimation means for estimating a running load from the estimated weight of the automobile, the acceleration, and the estimated output torque;

memory means for storing at least two shift schedules therein;

a shift schedule variable-control unit which determines a shift schedule of an automatic transmission of said drive train during actual running of said automobile on the basis of the estimated running load, the estimated weight of the automobile and the stored shift schedules; and

gear shift determination means for selecting a gear position of said automatic transmission based on the determined shift schedule;

wherein said output torque estimation means has a first mode in which said output torque is estimated from a turbine revolution speed of a torque converter of said automatic transmission and a revolution speed of an engine of said drive train, and a second mode in which said output torque is estimated from a throttle valve opening of said engine and said revolution speed of said engine, one of said first and second modes being selected in response to a ratio between an input and an output revolution speeds of said torque converter of said automatic transmission.

6. Method of controlling selection of gear position for automatic transmission of an automobile having means for storing a plurality of shift schedules for said automatic transmission, said method comprising the steps of:

first, calculating an estimated weight of said automobile;

second, determining acceleration of said automobile;

third, calculating a value for an output torque of said transmission based on torque characteristics of a drive train of said automobile and generating an output torque signal indicative of said output torque value;

fourth, estimating a running load of said automobile based on said estimated weight of said automobile, the acceleration, and the output torque signal;

fifth, selecting a shift schedule from among a plurality of shift schedules stored in said means for storing, based on the estimated running load and the estimated weight of the automobile; and

sixth, selecting a gear position of said automatic transmission based on the selected shift schedule;

wherein said third step comprises calculating said output torque based on torque characteristics of an engine of said drive train when a ratio between an input revolution speed and an output revolution speed of a torque converter of said automatic transmission is greater than a predetermined value, and calculating said output torque based on torque characteristics of said torque converter of said automatic transmission when said ratio is less than said predetermined value.

7. Method of controlling selection of gear position for automatic transmission of an automobile having means for storing a plurality of shift schedules for said automatic transmission, said method comprising the steps of:

first, calculating an estimated weight of said automobile;

second, determining acceleration of said automobile;

third, calculating a value for an output torque of said transmission based on torque characteristics of a drive train of said automobile and generating an output torque signal indicative of said output torque value;

fourth, estimating a running load of said automobile based on said estimated weight of said automobile, the acceleration, and the output torque signal;

fifth, selecting a shift schedule from among a plurality of shift schedules stored in said means for storing, based on the estimated running load and the estimated weight of the automobile; and

sixth, selecting a gear position of said automatic transmission based on the selected shift schedule;

wherein said third step comprises calculating said output torque based on at least torque characteristics of a torque converter of said automatic transmission, and torque characteristics of an engine of said drive train; and

wherein said third step comprises calculating said output torque based on said torque characteristics of the engine of said drive train when a ratio between an input revolution speed and an output revolution speed of said torque converter of said automatic transmission is greater than a predetermined value, and calculating said output torque based on said torque characteristics of said torque converter of said automatic transmission when said ratio is less than said predetermined value.

8. Control system for an automatic transmission with torque converter comprising:

first input torque estimating unit for estimating an input-torque of said automatic transmission using an engine torque characteristic;

second input torque estimating unit for estimating an input-torque of said automatic transmission using a torque-converter characteristic;

deviation calculating unit for calculating a deviation of said first input-torque and said second input-torque;

correcting unit for correcting said first input torque using said deviation torque;

control unit for controlling said automatic transmission according to said correction first input torque.

9. Control system for an automatic transmission with torque converter as defined in claim 8 wherein

output torque estimating unit for estimating an output torque of said automatic transmission using said correcting first input torque and a transmission ratio.

10. Control system for an automatic transmission with torque converter as defined in claim 9 wherein

acceleration estimating unit for estimating a vehicle acceleration;

flat road running load estimating unit for estimating a flat road running load using a vehicle speed, said acceleration and said output torque.

11. Control system for an automatic transmission with torque converter as defined in claim 10 wherein

transmission ratio control unit for controlling a transmission ratio of a vehicle according to said flat road running load.

add A2